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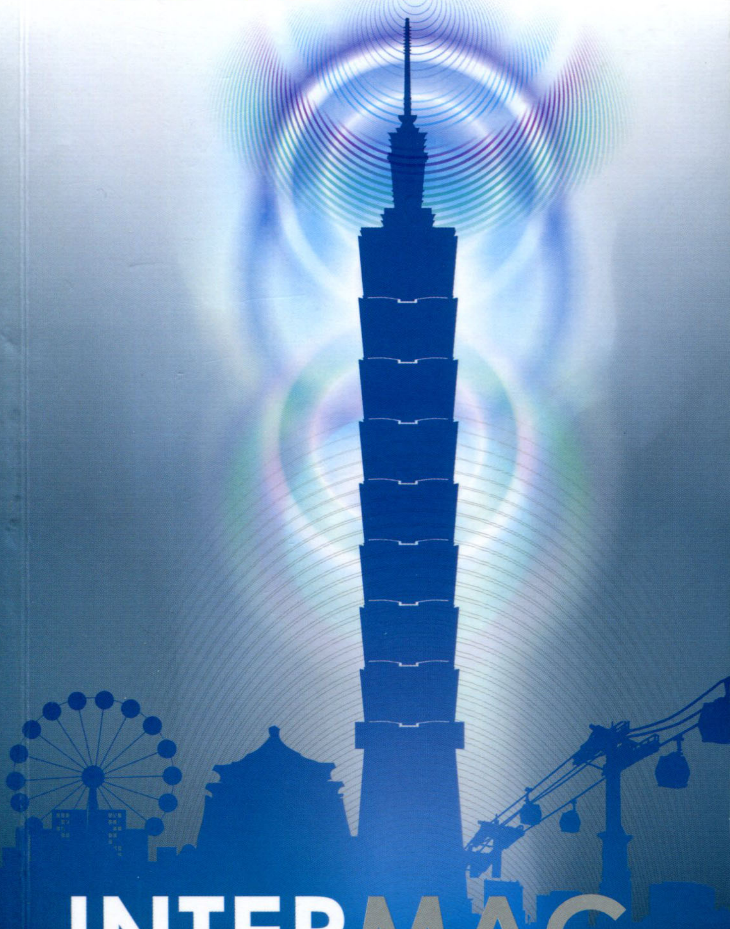

INTERMAG

ASIA International Magnetics Conference

TAIPEI 2011

Taipei, Taiwan April 25-29, 2011

BN-07

Investigation of Fe_3O_4 core/ mesoporous SiO_2 shell microspheres based on Mössbauer spectroscopy.

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<u>Introduction</u>

Recently, magnetic iron oxide nanoparticles have been considered to be an ideal candidate for biological application, both as a tag for sensing and imaging, and as an activity agent for antitumor therapy[1, 2]. The requirements for any biomedical application of magnetic colloids include the chemical stability, biocompatibility. Magnetic microspheres consisting of Fe_3O_4@SiO_2 core-shell have attracted attention as bio/medical application for its low coercivity, high saturation magnetization, and chemically stabilization[2, 3].

In this paper, we have studies the magnetic properties and hyperfine interaction of Fe_3O_4 and Fe_3O_4 core/SiO_2 shell, investigated with the magnetization curve and Mö ssbauer spectroscopy experiment.

<u>Experiment</u>

The Fe_3O_4 core and Fe_3O_4 core/mesoporous SiO_2 shell microspheres were prepared by a solvothermal reaction method. The crystal structure of the sample was examined by X-ray diffraction(XRD) with CuKα (λ= 1.540562 Å) radiation. The size and shape of the products were examined by high-resolution transition electron microscopy(HR-TEM). The magnetic properties were characterized using a vibrating sample magnetometer(VSM) and Mö ssbauer spectroscopy. Mö ssbauer spectra of Fe_3O_4 and Fe_3O_4 core/SiO_2 shell were recorded from 4.2 K up to room temperature with a ^{57}Co source in Rh matrix.

<u>Results and discussion</u>

The crystal structure of Fe_3O_4 core was determined by the Rietveld refinement technique. The crystal structure of the Fe_3O_4 core was cubic structure of *Fd*-3m with lattice constant a_0 = 8.395 Å. The Fe_3O_4 core/SiO_2 shell structure was confirmed by TEM as shown in Fig. 1. According to the measurement for magnetization curves at room temperature, the saturation magnetization of Fe_3O_4 and Fe_3O_4 core/SiO_2 shell microspheres are determined to be 77.0 and 17.0 emu/g, respectively. The Mö ssbauer spectra for the samples were analyzed of two six-line hyperfine patterns. The fitted data apparently verified that the prepared Fe_3O_4 and Fe_3O_4 core/SiO_2 shell samples have magnetite $[Fe^{3+}]_A[Fe^{2+}Fe^{3+}]_BO_4$. It is noticeable that the Mö ssbauer absorption area ratio between tetrahedral *A*(8*a*) and octahedral *B*(16*d*) site of the Fe_3O_4 core/SiO_2 shell shows enormous change compare with that of Fe_3O_4. The *A* and *B* site the area ratio of sextet increase from 40 : 60 to 55 : 45 for Fe_3O_4 and Fe_3O_4 core/SiO_2 shell, respectively, at room temperature. The magnetic hyperfine fields of *A* and *B* sites in Fe_3O_4 are $H_{hf}(A)$ = 517 kOe and $H_{hf}(B)$ = 493kOe, and Fe_3O_4 core/SiO_2 shell spheres are $H_{hf}(A)$ = 519 kOe and $H_{hf}(B)$ = 511 kOe, at 4.2 K. Hyperfine fields of *A* and *B* site in Fe_3O_4 are $H_{hf}(A)$ = 488 kOe and $H_{hf}(B)$ = 457 kOe, and Fe_3O_4 core/SiO_2 shell spheres are $H_{hf}(A)$ = 486 kOe and $H_{hf}(B)$ = 449 kOe, at room temperature, as shown in Fig. 2.

[1] Hong Deng, Xiaolin Li, Qing peng, Xun Wang, Jinping Chen, and Yadong Li, Angew. Chem. Int. Ed. **44**, 2782-2785 (2005).

[2] Yonghui Deng, Dawei Qi, Chunhui Deng, Xiangmin Zhang, and Dongyuan Zhao, J. Am. Chem. Soc. **130**, 28-30 (2008).

[3] Xiuqing Xu, Chunhui Deng, Mingxia Gao, Wenjia Yu, Pengyuan Yang, and Xiangmin Zhang, Adv. Mater. **18**, 3289-3293 (2006).

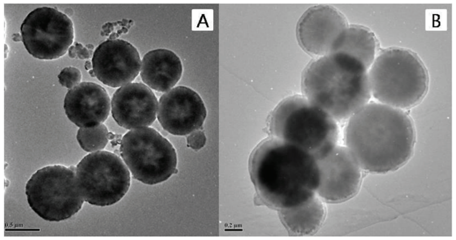

Fig. 1 HR-TEM images of (A) Fe_3O_4 particles, (B) Fe_3O_4 core/SiO_2 shell microspheres.

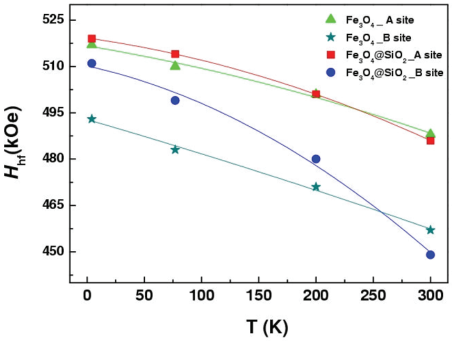

Fig.2 Magnetic hyperfine field of *A* and *B* sites for Fe_3O_4 and Fe_3O_4 core/SiO_2 shell as a function of temperature T.